PCT/AU01/00015

AU01/00015 #7

REC'D 07 FEB 2001
WIPO PCT

~~Patent Office~~
Canberra

4

I, JONNE YABSLEY, ACTING TEAM LEADER EXAMINATION SUPPORT & SALES hereby certify that annexed is a true copy of the Provisional specification in connection with Application No. PQ 5041 for a patent by NORTON (NO. 325) PTY LIMITED filed on 11 January 2000.

COMMONWEALTH OF AUSTRALIA
AUSTRALIA
PATENT OFFICE

WITNESS my hand this
Second day of February 2001

J R Yabsley

JONNE YABSLEY
ACTING TEAM LEADER
EXAMINATION SUPPORT & SALES

PRIORITY DOCUMENT
SUBMITTED OR TRANSMITTED IN COMPLIANCE WITH RULE 17.1(a) OR (b)

TITLE: A METHOD FOR DISTRIBUTION OF STREAMED DATA PACKETS ON A SWITCHED NETWORK UTILISING AN INTELLIGENT DISTRIBUTION NETWORK

INTRODUCTION:

The invention relates to a system and method for distributing streamed data in a way that minimises network irregularities intrinsic to data switched networks that cause consecutive data packets to arrive at a client adaptor with time inconsistencies that are far greater than the alibility of the client to deliver contiguous data packets to its application software and / or minimises the likelihood of data packet loss during the transfer process from the host to the client. In a further embodiment the system or method decreases the latency of data stream delivery to a client adaptor when a plurality of clients exist receiving that stream. In a further embodiment the sustained maximum data rate to the client adaptor is maximised. Such distribution system optimises network capacity.

BACKGROUND TO THE INVENTION:

The Internet is a lose network of connected computers and network enabled devices that use a network protocol called Transfer Control Protocol (TCP) and a native addressing system called Internet Protocol (IP). The network transmission called TCP/IP is a combination of these two means to deliver data from a source adaptor, called the host, to a destination adaptor, called a client. Any computer or network-enabled device can be both a host and a client simultaneously.

The method of TCP/IP involved the breaking down of large data blocks into a plurality of smaller pieces called data packets. These packets are small enough to be transmitted by asynchronous transmission electronic devices and allow for multiplexed use of one unique transmission medium by a plurality of transmitted data. Further to this, when TCP/IP breaks data into a plurality of packets it assigns packet order information within each packet so that when it arrives at a client adaptor the packets can be contiguously reordered to eliminate events whereby a packet arrives to the client adaptor out of order due to intrinsic network behaviour. Further to the above, TCP/IP can decide based of intrinsic packet timing criteria, that a packet has been lost or its reception by the client adaptor has been unacceptably delayed in the network transmission process whereby a request is made from the client adaptor to the host adaptor to retransmit that lost or unacceptably delayed packet. The greater the numbers of lost or unacceptably delayed packets the greater overall decrease to network capacity.

The IP process is used to address host and client adaptors such that they have uniquely identifiable electronic locators, called IP Addresses. These IP locators are virtual and do not necessarily exist in defined physical geographical location, however there has been some standardised interrelation between IP address and physical geographic locations. The IP component is responsible for Internet work delivery of data packets.

Data networks are typically built on asynchronous transmission electronic devices called routers, switches, hubs, bridges, or otherwise, and interconnects formed in hard wire, fibre optic, satellite, infra red, and other wireless, or alternative mediums. A network is defined as a virtual electronic interconnection whereby a data packet from a host adaptor will arrive to all client adaptors on that network. That is, a data packet transmitted from a host into a hub device will result in that data packet being sent to all interconnected clients on that network. A switch or router device has the extra ability to identify the data packets' destination IP electronic address as either existing on the network from where it came, and will therefore block the transmission of the data packet onto an external network, or existing on an external network and forward the data packet onto another external network. Thus, data packets are filtered so that only data meant for an external network will be allowed to pass through. This is called 'segmenting a network' and is the base of Wide Area Networking (WAN) and the Internet.

It is not untypical that a data packet that passes through a hub or switch device may typically incur approximately 40 milliseconds of delay, or latency. As stated previously, a router devices, and switch, have intelligence whereby they analyse the destination address of a data packet and direct the transmission of the data packet to a predetermined electronic link in a predetermined electronic direction. It is the interconnectivity of these data switching devices that allows data to theoretically be transmitted from any host adaptor to any client adaptor, irrespective of their geographical location. It is possible that there is a plurality of possible electronic data paths that a packet can take to be transmitted from a client adaptor to a host adaptor and a data block, when broken into a plurality of packets, may arrive to the client adaptor over a plurality of electronic data paths. On any one of these paths it is possible that there exists a plurality of router, switch, hub, bridge or the like asynchronous transmission electronic devices. It is possible that a contiguous set of data packets sent from a host adaptor to a client adaptor may incur considerable timing disruptions to cause the contiguous arrival of these packets at the client to be impossible. It is also possible that the time required to travel from the host adaptor to the client adaptor can be a plurality of typically approximately 40 milliseconds of delays causing the total delay time for data packet transmission to exceed acceptable ergonomic requirements.

The asynchronous transmission electronic devices called routers, switches, hubs, bridges, and interconnects formed in hard wire, fibre optic, satellite, infra red and other wireless, or alternative mediums, have theoretical maximum capacity termed bandwidth. Bandwidth is the theoretical maximum throughput of data in terms of bits per second. In a typical Internet connection a client is linked to an Internet Service Provider (ISP) through a Public Telephone Standard Connection (PSTN) with a modem as the client adaptor and another modem at the Internet Service Provider to form a segmented electronic network. Typically, as at the time of writing of this patent application, this segmented electronic network may have a bandwidth capacity of fourteen thousand, four hundred bits per second to sixty four

thousand bits per second. Broadband Internet Service Providers (BISP) offer larger bandwidth capacity than that which is available on a PSTN link or switch, but essentially work in a similar role of that of connecting the client to a router or switch at the Internet Service Provider.

Each client, wherever possible exists on a segmented network so that only data destined for that client travels to the client adaptor. All data to or from all client adaptors are combined at the Internet Service Provider. The combined data at an Internet Service Provider can be managed easily by having asynchronous transmission electronic devices or otherwise within the Internet Service Provider Local Area Network (LAN) that can achieve typical bandwidths of many gigabits per second. Therefore data that is available at the Internet Service Provider can be streamed to clients of that Internet Service Provider with maximum network capacity and minimal loss of packets or unacceptable delayed data packets. The art describes this network as being as that of the Client Connection.

When a client adaptor requests information from an electronic location not contained within the Internet Service Provider Local Area Network infrastructure, Wide Area Network is used to connect the Internet Service Provider or Broadband Internet Service Provider asynchronous transmission electronic devices, or otherwise, to the host IP electronic location. Typically in this instance the client may reside in one country whilst the host is in another, or the client may reside in one city while the host resides in another. The asynchronous transmission electronic devices, or otherwise, which provide this inter-city or inter-country connectivity usually have bandwidth capacity less than that of the Internet Service Provider Local Area Network. The cost of use of Wide Area Network is typically far higher than that of the cost of use of the client to Internet Service Provider Local Area Network. The electronic interconnection of networks through Wide Area Network is void of geographical awareness, and therefore the Wide Area Network connectivity is more expensive in its use of data transmission even when two locations exist geographically contiguous but are separated by electronic interconnection over a Wide Area Network.

For Example, In figure 5, Streaming Media Distribution Server, 80, is connected to the internet by three links, 81, 82, and 83, to form an aggregated 300Mbps Multiple Link. This link exists in Colorado. The Streaming Media Client, 86, is connected to a Local Internet segment, 85, in California. California and Colorado are interconnected over WAN, 84, by a 10 Mbps link. Thus the bandwidth outside of the infrastructure of the Streaming Media Distribution Server, 80, reduces from 300 Mbps to 10 Mbps when geographical distance becomes involved.

The Internet was initially perceived and designed to carry text-based email and Hyper Text Transfer Protocol (HTTP) encoded documents. This encoding method reduces the data size requirement between host and client adaptors. Performance of the Internet using HTTP and text based email is not critically time dependent and intrinsic latency of the Internet infrastructure

as described previously is ergonomically acceptable. A typical client interacting with a home site, or email, may only utilise the bandwidth capacity for 10% of the time.

As data size and demand has increased though the introduction of concepts like the NET PC, a computer that uses the Internet to store its data, and multimedia content data, which intrinsically contained significantly larger data size than the previously existing Internet data content, has started to saturate the Internet Wide Area Networks and its ergonomic performance has become unacceptable. This is most relevant in real time applications where network timing and sustained data rates are critical. Such applications include, but are not limited to, video and audio broadcasting over the Internet. This streamed data can have bandwidth requirements of sustained data rates of full bandwidth capacity for 100% of the time.

In a typical Internet Service Provider Local Area Network it is possible that the Internet Service Provider can stream the aggregated bandwidth requirement of a plurality of clients streaming a plurality of data packets. The Internet Service Provider Local Area Network aggregated bandwidth can require sustained data rates of full bandwidth capacity for 100% of the time. The Internet Service Provider can only provide this service to the clients if they can stream the data from a Stream Media Server (SMS) located within their Internet Service Provider Local Area Network. The cost of such servers typically limit the application of these Streaming Media Servers into Internet Service Provider Local Area Networks and content providers are often reluctant to provide content due to issues of copyright protection and royalty/licensing fees that are not addressed or are not favourably accepted by the content providers. Also the storage capacity of the Streaming Media Server often will limit the choice of content available to the clients of that Internet Service Provider. For quality of choice, and market demand forces, the Internet Service Provider often has to source its content from Streaming Media Servers beyond the Internet Service Provider Local Area Network and therefore allow the client invoked data stream to source its content from external electronic networks (Wide Area Network). Therefore the cost to the Internet Service Provider / Broadband Internet Provider is increased over and above that if the content where streamed from within their Internet Service Provider Local Area Network.

When clients of an Internet Service Provider /Broadband Internet Provider are allowed to source stream data from the Wide Area Network electronic external networks the aggregated bandwidth delivery cost are high for the Internet Service Provider and more often the bandwidth capacity of the Internet Service Provider network link onto the internet backbone via Wide Area Network is limited far below the aggregated bandwidth of the demand for externally requested stream data of the clients of the Internet Service Provider (Figure 5). Often when such demand occurs there is unacceptable network performance inducing loss and unacceptably delayed packets.

The cost to the Internet infrastructure to renew asynchronous transmission electronic devices with modern variations such as frame relay, and ATM that address the latency and contiguous data arrival issues is expensive. Further to this an effort has been made to introduce a multicast broadcast protocol that allows more efficient use of the network bandwidth, and multicast enabled routers, that address redundant data transmission over Wide Area Network for real time (live) streamed data, are expensive.

Multicast can be most effective when a plurality of clients are watching the same content simultaneously.

Typically, Multicasting across a public network structure requires an enormous amount of participation by Internet Service Providers.

A unique 32-bit number (IP Address) identifies computers connected to a TCP/IP network structure. This identification number is commonly represented in a format known as dotted notation, and takes the form aaa.bbb.ccc.ddd where aaa, bbb, ccc, ddd are each in the range of 0 – 255, further these are known in the art as octets. IP addresses are typically allocated to distribution bodies in groups know as classes. Address classes are ranges of IP numbers with common leading octets. Each class is given a name as indicated by the following format examples

aaa.bbb.ccc.x Class C address set
aaa.bbb.x.x Class B address set
aaa.x.x.x Class A address set

SUMMARY OF THE INVENTION:

This invention describes an Intelligent Distribution System that efficiently and effectively distributes streamed data over packet switched networks by means of an Intelligent Distribution Network (IDN) incorporating Streaming Nodes (SN) that preferably exist within one electronic connection from the client adaptor (Internet Service Provider Local Area Network). Unlike other embodiments (Intervu, US Patent 6,003,030) no client software is required and the system is transparent to the USER on the client adaptor network enabled device or computer.

The client is directed to an Intelligent Distribution Network controller by requesting a stream from anywhere on the Internet. The host refers the client to a pre ordained Intelligent Distribution Network centre which inturn refers the client to its best performance network link Streaming Node. The Streaming Node then delivers the stream data to the client over that best performance network link. The best performance network link may consist of a plurality of asynchronous transmission electronic devices such as routers, switches, hubs, and bridges or otherwise and interconnects formed in hard wire, fibre optic, satellite, infra red and other wireless, or alternative mediums.

Content, available from Streaming Media Server's, is fed to the Streaming Node under the supervision of the Intelligent Distribution Network /Streaming Nodes system. The Streaming Media Server is required to serve one stream only to the Streaming Node, which in turn temporarily buffers the stream in its cache and on-streams as many streams as are requested by the singularity or plurality of client adaptors that the Streaming Node is delegated and is physically able. The client adaptor will preferably exist on only one electronic network link, that of the Client Connection. The Intelligent Distribution Network / Streaming Nodes system can invoke load sharing between contiguous, or otherwise, Streaming Nodes, when client adaptor demand is high and the streaming resources of the aggregated Streaming Nodes within an Internet Service Provider or otherwise are 100% utilised.

By using the Intelligent Distribution Network /Streaming Nodes system and method described in this patent application, Wide Area Network use will be reduced to an optimum given its limited capacity bandwidth. The streams from Streaming Media Servers are sent in a single stream to the Streaming Nodes and therefore a plurality of streams of the same content to client adaptors within the same class of client adaptors fed from the same Streaming Node is not required and Wide Area Network usage and associated expenses are conserved. The streaming node exist preferably within one network hop to the client adaptor therefore ensuring packet loss is reduced and unacceptably delayed packets are reduced allowing maximum sustained data rates to the client adaptor through the most effective network electronic path. Further, when a client adaptor is already receiving a stream from a streaming node any further client adaptors wishing to receive the same data stream will incur minimal relative ergonomic latency in receiving the stream on their client adaptor.

Further to this the Intelligent Distribution Network /Streaming Nodes system and method described in this patent application is used to manage content, pay per view, user access rights, emergency broadcast channels insertion, advertising channel insertion, performance or otherwise royalty payment e-commerce transactions, billing by the bit streamed, time, or content, and other critical commercial issues involved in the distribution of product through a distribution system.

In a further embodiment it is possible for Streaming Media Servers to utilise the Intelligent Distribution Network /Streaming Nodes, whether or not the Streaming Media Server exists on the same Internet Service Provider Local Area Network that is connected over the Client Connection to the client adaptor, whereby the Intelligent Distribution Network /Streaming Nodes is used to manage commercial transactions, reduce network jitter and packet loss or unacceptably delayed packets, or to more efficiently utilise Wide Area Network bandwidth when delivering content to a singularity or a plurality of client adaptors within the same IP class address range.

BRIEF DESCRIPTION OF THE DRAWINGS:

Figure 1 - A representation of prior art Streaming Media Delivery systems

Figure 2 - A representation of how the Intelligent Distribution Network system automatically derives which streaming node is best suited to stream to a client adaptor

Figure 3 - A system diagram of the Intelligent Distribution Network controller

Figure 4 - A representation of how the prior art shown in figure 1 can be improved by the addition of the Intelligent Distribution Network system

Figure 5 - A representation of a typical Wide Area Network link

Figure 6 - A simplified representation of the Intelligent Distribution Network system process

Figure 7 - A content path systems diagram showing how content is delivered into and out of a Streaming Media Distribution Centre

Figure 8 - A representation of how a concatenated array of Streaming Nodes can be used to build a worldwide intelligent distribution system for the Internet

DETAILED DESCRIPTION OF THE INVENTION:

The invention is described below, with references to detailed illustrative embodiments. It will be apparent that the invention can be embodied in a wide variety of forms, some of which may be quite different from the preferred embodiment described in this patent. Consequently, the specific structural and functional details disclosed herein are merely representative and do not limit the scope of the invention.

The prior art embodiments shown in figure 1 shows a client, 1, connected to the Internet, 2, and a plurality of Streaming Media Servers, 3, 6, 7, and 8, by a Wide Area Network infrastructure, 4. In one form of prior art the client, 1, through their network adaptor connects to their Internet Service Provider, 5, which therefore provides the Client Connection. The Internet Service Provider, 5, inturn is connected to the Wide Area Network infrastructure, 4, that forms the Internet, or an intranet, extranet or otherwise. The client adaptor will request content from any Streaming Media Servers, 3, 6, 7, and 8, which will stream that content directly to the client, 1, over the Wide Area Network infrastructure, 4. This will incur maximum cost to that client and/or their Internet Connection Provider as it represents exclusive use of Wide Area Network bandwidth as it is used by the streamed data for the benefit of one client only.

In other prior art, as described by Intervu, US Patent 6,003,030, a client software application, 9, exists which interrogates known Streaming Media Servers, 3,6,7and 8, using trace route between the client adaptor and the Streaming Media Servers adaptors. Thus, some further selection sensitivity between the client and the Streaming Media Servers can exist to determine which of the Streaming Media Servers, 3, 6, 7, and 8, is best suited to serve their data stream directly to the client adaptor, but still usually, but not exclusively, over a Wide Area Network infrastructure thus likely to incur maximum cost to that client or their Internet Connection Provider as it represents exclusive use of Wide Area Network bandwidth as is it used by the streamed data for the benefit of one client only.

In the system invented and described by this patent application, the Intelligent Distribution Network /Streaming Nodes structure will act as a distribution system between the Streaming Media Servers, 3, 6, 7, and 8, and the client whether or not the Streaming Media Servers or the client incorporate any prior art method of determining which Streaming Media Servers, 3, 6, 7, or 8, is best suited to serve content to the client.

The Intelligent Distribution Network /Streaming Nodes system works without any client software required on the client computer or network enabled device. Figure 4 shows how the addition of the IDN System, 77, has removed the need to run any client application software as is described by prior art, Intervu, US Patent 6,003,030.

To achieve functionality without the assistance of, an application resident on a client the following process is used.

When a client selects a stream media content item from a place on the Internet a Uniform Resource Locator (URL) is used. The Uniform Resource Locator may be in the form of;

http://IDN1.domainname.com/?Stream=ABCDEFGHIJKL

In this Uniform Resource Locator example the IP electronic location of the Intelligent Distribution Network is given by the domain address. That is, working backwards, the domain is a dot com, thus is a commercial site, the domain name is given by 'domainname' and is therefore directed by the Domain Name Server system to the IP address of the Intelligent Distribution Network Internet Service Provider, and the prefix IDN1 indicates the name of the server device within that Internet Service Provider. That is, the Intelligent Distribution Network system server is IDN1 at the domain called domainname.com. The Uniform Resource Locator also defines the content the client wished to stream. In this instance the suffix /?Stream=ABCDEFGHIJKL defines a stream item and ABCDEFGHIJKL is the Globally Unique Identifier of the stream content. The Intelligent Distribution Network cache will use the Globally Unique Identifier for the stream content to lookup Streaming Nodes that are currently acting or are

available to act as on-stream buffers for that content event. The Intelligent Distribution Network will further use the Globally Unique Identifier for the stream content to lookup Rights Management, Distribution Billing, and current and expected commercial and technical issues related to that streamed content.

Further to the previous Globally Unique Content Identifier the Uniform Resource Locator may contain additional embedded information, which may include, for example, Globally Unique Identifiers referencing from where the request was made, and other appropriate commercial or useful information.

The Intelligent Distribution Network has a self propagated infrastructure of Streaming Nodes and Intelligent Distribution Network servers which can provide an encapsulated infrastructure that can be used to manage content, pay per view, user access rights, emergency broadcast channels insertion, advertising channel insertion, performance or otherwise royalty payment e-commerce transactions, billing by the bit streamed, time, or content, and other critical commercial issues involved in the distribution of product through a distribution system.

The databases contained in the Intelligent Distribution Network includes a content management system and a node controller that associate Globally Unique Identifiers for the stream content with Streaming Nodes and they are maintained by content providers, and streaming node operators, which is performed through the internet as is well known in the art by methods such as active server pages or other internet management systems. Further to this, there are other tools such as a log controller and a public web site/gateway that allow a streaming event to be setup by a content provider or a streaming node operator and which will also collect market demographics, commercial data, network performance data, and the like. Further embodiments of this gateway include online encoding, transaction processing and the like.

After receiving this initial request for a unique stream content identifier from a clients' location the Intelligent Distribution Network will first look up the client's IP class to see if it has existing information in the Intelligent Distribution Network cache about which Streaming Node, of the Streaming Nodes which are currently on-streaming that content or enabled to on-stream that content, is best suited to serve that client. If this information does not exist, or if a preset time period has the stored data as being out of date, the Intelligent Distribution Network will initiate a trace route to the client. This trace route will typically be completed in 500 milliseconds.

The result of the trace route from the Intelligent Distribution Network to the client is then matched against known trace routes for Streaming Nodes contained in a lookup table in the Intelligent Distribution Network cache that

are currently on-streaming that content or enable to on-stream that content. Trace route results for these content matched Streaming Nodes are analysed by the Intelligent Distribution Network whereby the class of each hop in a Streaming Nodes' trace route result is matched against the trace route from the Intelligent Distribution Network to the client adaptor.

This process will provide a hierarchical estimate of a plurality of most likely 'electronically best performing' network links from the client to known Streaming Nodes. From this lookup table a trace route is then performed between each of the possible tendered Streaming Nodes nominated for the nominated client. This then details the network paths and performance between selected Streaming Nodes and the client. The best performing Streaming Node of this tendered batch of Streaming Nodes is then allocated to stream the data to the client adaptor. This network intelligence may then feed to a neural net system, or otherwise, within the Intelligent Distribution Network /Streaming Nodes system for future learning and for modification to Streaming Nodes / Client mappings to more effectively run the intelligent distribution network. It may also be possible for Intelligent Distribution Network managers to manually allocate Streaming Nodes /client class mappings for reasons intrinsic to their own operation. These manual, or automatic mappings may contain time of day and other variances and therefore constitute what the art terms 'quality of service' enhancement to the Intelligent Distribution Network system.

For example, in figure 2, client, 10, is connected to Intelligent Distribution Network, 11, via 4 network hops, 12, 13, 14, and 15. The resultant trace route from the Intelligent Distribution Network, 11, to the client, 10 are shown in table 1.

1	10ms	IDN	[192.168.1.200]
2	118ms	A	[203.168.37.29]
3	207ms	E	[203.156.34.25]
4	217ms	H	[203.45.36.127]
5	189ms	Client	[210.45.67.78]

Table 1 - Intelligent Distribution Network to Client trace route result

The Intelligent Distribution Network then compares known trace route results from the Intelligent Distribution Network cache for Streaming Nodes registered with this Intelligent Distribution Network Server. In figure 2 the trace route result for the path between the Intelligent Distribution Network, 11, and Streaming Node 1,16, is shown in table 2.

1	10ms	IDN	[192.168.1.200]
2	118ms	A	[203.168.37.29]
3	207ms	B	[191.156.134.25]
4	217ms	D	[200.45.36.127]
5	189ms	G	[201.145.67.178]
6	169ms	Streaming Node 1	[186.47.167.178]

Table 2 - Intelligent Distribution Network to Streaming Node 1 trace route result

In figure 2 the trace route result for the path between the Intelligent Distribution Network, 11, and Streaming Node 2, 3, 5, is shown in table 3.

1	10ms	IDN	[192.168.1.200]
2	118ms	A	[203.168.37.29]
3	207ms	E	[203.156.34.25]
4	207ms	C	[193.76.34.25]
5	217ms	F	[206.45.36.12]
6	189ms	Streaming Node 2	[134.145.67.178]

Table 3 - Intelligent Distribution Network to Streaming Node 2 trace route result

When the class matching of these trace route result of table 1 and table 2 are compared, it is at network hop 2, point A, 26, in figure 2, that the Intelligent Distribution Network registers a direction change in data transmission path. Similarly, it is at Point E, 27, in figure 2 that the class matching ceases to resolve indicating to the Intelligent Distribution Network system that the data packets cease to travel on the same electronic path. Whilst many other Streaming Nodes are also compared it may be that in the first instance, Streaming Node 1 and Streaming Node 2 are nominated as the possible best locations to serve the client, 10, from a tendered sub set of Streaming Nodes analysed from the Intelligent Distribution Network cache.

The Intelligent Distribution Network then passes the reduced tendered set of a plurality of Streaming Nodes to the detailed interrogation routine. This routine traces the route between Node 1, 16, to the client, 10. The results of which are shown in table 4.

1	10ms	Streaming Node 1	[186.47.167.178]
2	56ms	G	[201.145.67.178]
3	207ms	D	[200.45.36.127]
4	217ms	B	[191.156.134.25]
5	189ms	A	[203.168.37.29]
6	207ms	E	[203.156.34.25]
7	217ms	H	[203.45.36.127]
8	315ms	Client	[210.45.67.78]

Table 4 – Streaming Node 1 to Client trace route result

Similarly, the trace route results from Streaming Node 2 to the client are shown in table 5.

1	10ms	Streaming Node 2	[134.145.67.178]
2	57ms	F	[206.45.36.12]
3	207ms	C	[193.76.34.25]
4	217ms	E	[203.156.34.25]
5	217ms	H	[203.45.36.127]
6	189ms	Client	[210.45.67.78]

Table 5 - Streaming Node 2 to Client trace route result

It would seem that the electronic path between Node 2 to the client is tentatively best suited to on-stream content to the client adaptor as the network response time is 189ms as apposed to 315 msec on the Node 1 path to the client. Streaming node 2 will then be allocated to the client as its stream source and will serve the data stream.

It is possible that an intermittent link, or otherwise, may exist in the path between Streaming Node 2 and the client adaptor indicating that the result of the trace route is unreliable. This will be become evident if network performance data is returned from the Streaming Nodes to the Intelligent Distribution Network by the log system. Therefore this feedback may cause the Intelligent Distribution Network to modify client/Streaming Nodes mappings.

It may be that in some instances a peer link, 30, connects the Internet Service Provider G, 31, to the Internet Service Provider H, 32. When the trace route is performed between the Intelligent Distribution Network and the Streaming Nodes 1 and 2 the existence of this peer link may not be detected. When, in this case, the trace route is performed between Streaming node 1 and the client, the new trace route results are shown in table 6.

1	10ms	Streaming Node 1	[186.47.167.178]
2	56ms	G	[201.145.67.178]
3	75ms	H	[203.45.36.127]
8	77ms	Client	[210.45.67.78]

Table 6 - Streaming Node 1 to Client trace route result including the peer link

In this instance it is clear that Streaming Node 1 is the better Streaming Node to serve the data stream to the client adaptor. There is only 77ms of network latency and the electronic path is minimal. The peer link may be Wide Area Network but it maybe used exclusive for data sharing between Internet Service Provider G, 31, and Internet Service Provider H, 32. It may incur less Wide Area Network cost then does the greater Wide Area Network infrastructure of the Internet. Streaming Node operators can naturally factor

WAN cost into Streaming Node to Client Class mapping in the Intelligent Distribution Networks cache.

Further to this it is possible that the client may be connected directly to Internet Service Provider F, 34, via a Client Connection, 33. In this instance the trace route would yield a trace route result for Streaming Node 2 to the client adaptor as shown in table 7.

1	10ms	Streaming Node 2	[134.145.67.178]
2	22ms	Client	[210.45.67.78]

Table 7 - Streaming Node 2 to Client trace route result including a direct client Internet Connection Provider link.

In this instance the network path between streaming node 2 and the client is only one direct electronic path with a latency of 22ms. It would be best for the Intelligent Distribution Network to allocate Streaming Node 2 to the client, 11.

The trace routes performed in the class mapping procedure, between the Streaming Nodes and the client adaptor, can be performed simultaneously and typically all be completed in 500 milliseconds or less. Thus the cumulative time between the initial trace route from the Intelligent Distribution Network to the Client, and the consecutive class mapping trace route from the selected Streaming Nodes to the client can be completed typically in a total time of 1 second or less, therefore resolving as ergonomically acceptable to the user.

Once a client is assigned a streaming node the Intelligent Distribution Network cache is updated with that clients class/streaming node mapping and this result can be further used for any other clients originating from the same class IP address range without going through the class mapping procedure again. Thus, when a popular site is receiving a plurality of 'hits' from a plurality of clients, a high yield of these clients can be directed to their electronically closest streaming node from stored client class/streaming server mapping results contained in the Intelligent Distribution Network cache, obtained from previous client request for the content material. As stated previously, manual override of Intelligent Distribution Network learnt results could be inputted to make the Intelligent Distribution Network behave as biased by a Streaming Node operator.

In figure 2, any of the Streaming Media Servers, 3, 6, 7, or 8, may be invoked by the Intelligent Distribution System, 11, to serve the requested content over the Wide Area Network, 4, to a client, 10, via the delegated Streaming Node if an existing stream of that content does not already exist as a stream to that Streaming Node.

In a further embodiment the IDN site may itself contain a Streaming Media Server. In figure 6, a Live source, 300, is encoded by an Encoder Station, 301, and is delivered by either the Public Internet, 302, or a satellite, 303, or

an ISDN / PSTN Dialup, 304, link or any other form of network link, to a Streaming Media Distribution Centre which functionally includes "Live" Streaming Node Distribution, 305, "On Demand" Streaming Node Distribution, 306, an IDN System, 307, and an IDN Storage / Cache System, 308. When a ISP Dialup Stream Client, 312, initially request a stream content, a Stream request, 313, is accepted by the IDN System, 307, over the Backbone Internet Connection, 310. The IDN System, 307, then performs a Client 'Distance' Function, 314 between itself and the client, 312. The IDN System, 307, will then refer to the Client 'Distance' Function to the IDN Storage / Cache System, 308, to identify possible Streaming Nodes, 311, 320, and 319, which compare favourably to the class match of the Client 'Distance' Function, 314. The IDN System, 307, then requests that Streaming Node 1, 311, Streaming Node 2, 320, and streaming Node 3, 319 perform a Stream Server 'Distance' Function, 318, to the client, 312. From the Stream Server 'Distance' Function results, the IDN System, 307, then delegates a Streaming Node, in this instance streaming Node 1, 311, to serve the content to the client, 312. The IDN System configures the Streaming Node for the content, 307, over the Backbone Internet Connection, 309. The IDN System, 307, then redirects the client, 312, to Streaming Node 1, 311 over the Client Stream Connection To calculated Best server, 316. Upon Streaming Node 1, 311, receiving the client connection, 316, content, as configured by the IDN System, 307, then is pulled from either/or "Live" Streaming Node Distribution, 305, and "On Demand" Streaming Node Distribution, 306.

Figure 3 shows an overall view of the functional blocks of the preferred embodiment of the Intelligent Distribution Network system. It consist of the internet, 100, connected via a firewall, 101, to three functional blocks, the Intelligent Distribution Network Redirection Controller, 102, the Intelligent Distribution Network System management, 103, and the Website Interface, 104.

The Intelligent Distribution Network Redirection Controller, 102, is the functional block which receives request for content streams from client adaptors originating from anywhere on the Internet. It consists of two sub functional blocks, the Trace Engine, 105, and the Content Management Controller, 106. The trace engine, 105, performs the location identification of client adaptors, Streaming Nodes to client adaptor relationship analysis, streaming node to client on-streaming delegations, and caches the results in the Network Trace Cache, 107, as described in detail previously.

The Content Management Controller, 106, is the content awareness sub system that stores a list of available content deliverable by the system. This information is stored in the Stream database, 108, or otherwise information storage kernel.

The Intelligent Distribution Network System Management sub system, 103, includes a Node controller, 109, and a Log management controller, 110. The Node Controller, 109, allows the Intelligent Distribution Network system to remotely control and configure Streaming Nodes. For example, the node

controller is used by the other functional sub systems in the Intelligent Distribution Network to configure a streaming node to receive a stream of content from a Streaming Media Servers anywhere on the internet in preparation for on-streaming to client adaptors which that streaming node is delegated by the Intelligent Distribution Network Redirection Controller, 102, to serve. Further, the Node Controller, 109, allows the collection of statistical information from Streaming Media Servers and other network management devices about the performance of the network, and other commercial information including but not limited to client content usage, Client Connection and Internet Service Provider Local Area Network, and other network performance data between the streaming node and the client adaptors. The Intelligent Distribution Network Redirection Controller, 102, may use this information to override stored client class/Streaming node maps.

The node database, 111, or equivalent information store, stores all the information pertaining to individual Streaming Nodes. For example, this information may include the Streaming Nodes' Globally Unique Identity, its IP address, or group of IP addresses, the Streaming Nodes client serving capacity, the rules of client serving including limitations of client number to any specific content stream, and the scope of client IP classes included and excluded from that streaming node or content.

The Log Management Controller, 110, processes the received log statistics from Streaming Nodes and interrogates the data to yield to other subs systems information that is used by the Intelligent Distribution Network system. These results, and logs, are stores in the Log/Stat database, 112, or otherwise information storage system.

Where appropriate, the website Interface, 104, allows managers of networks and content to access the Intelligent Distribution Network individual databases, 107, 108, 111, 112, and 114, to download data or upload data, and allow content providers access to specific configuration information and statistical analysis in respect to the streams of content delivered by the system. This includes the use of the Website Access Controller, 113, which uses security means, and website pages which may include or be linked to an external processing engine, such as the back end of a web site, which allows the users to interface with the desired and appropriate sub systems and databases of the Intelligent Distribution Network system. The website database, 114, or other information storage mechanism, stores the web functional information and applications.

In a further embodiment the Content Management Controller, 106, allows for advertising material to be inserted within the system either before or after a streamed event or during a streamed event. The later is achieved through the enhanced functionality of the relationship between the Streaming Media Servers streaming to a streaming node and that Streaming Nodes ' ability to buffer content whilst advertisements are streamed to the client adaptors after which buffered content is again delivered to the client adaptors. For

example, television content can be delivered from one country to another by the Intelligent Distribution Network system, with minimal international Wide Area Network usage of bandwidth (one stream only) but local advertising content can be inserted at the points in which the originating advertising takes place.

In a further embodiment the Content Management Controller, 106, allows for emergency broadcasts to be inserted into streams being on-streamed to certain classes of client adaptors of learnt geographical location. For example, if a tidal wave is predicted off the coast of a country, the local tidal wave prediction centre can access the Intelligent Distribution Network emergency broadcast functions for a specific location and interrupt streams with suitable emergency warning content. Similarly, if police where required to evacuate a residential area or office block, it could take control of the emergency channel to stream new content delivered to those areas.

In a further embodiment the streaming node is interactive beyond simply receiving a stream from a Streaming Media Servers, and on-streaming the content to client adaptors, in that it can allow client adaptors to interface with other online sites which form part of the interactivity of a composite stream presentation. For example, the online voting against a news item as to whether a user agrees or disagrees to a current affairs issue, and for those results to be simultaneously streamed back as part of the content to the client adaptors. Further, the content provided, in a live stream situation may include in the stream other interactive data that the Streaming Nodes pass between client adaptors and other sites on the Internet.

In a further embodiment, tiered Streaming Nodes may be used, for example, to import a stream content from one country to another as one single stream over an international Wide Area Network, whereby the initial received stream on-streams to a plurality of Streaming Nodes which in turn on-stream to client adaptors or more streaming nomes. In figure 8, a Streaming Media Distribution Centre, 200, such as that described in figure 6, and figure 7, feeds stream data over a dedicated 100Mbps Fibre Connection, 201, to a High Capacity Internet Backbone, 202. The High Capacity Internet Backbone, 202, feed these streams onto a plurality, or singular, of level 1 Streaming Nodes, 203, which consist of Internet Connection Providers. The level 1 Streaming Nodes, 203, on-stream the content to a plurality, or singular, of level 2 Streaming Nodes, 204, which consists of large Internet Service Providers. The level 2 Streaming Nodes, 204, on-stream the content to a plurality, or singular, of level 3 Streaming Nodes, 205, which consist of medium Internet Service Providers. The level 3 Streaming Nodes, 205, on-stream the content to a plurality, or singular, of level 4 Streaming Nodes, 206, which consists of small Internet Service Providers or Corporate Intranets. The level 4 Streaming Nodes, 206, on-stream the content to a plurality, or singular, of client adaptors, 207. In this method a vast number of client adaptors can receive stream data with minimal packet loss or minimal unacceptably delayed packets therefore ensuring sustained data rates of

100% bandwidth capacity for 100% of the time from a single stream source. Such method is suitable for worldwide broadcasts.

In a further embodiment, the IDN system is used for software applications that are delivered to the client adaptor as a data stream where they install applications on the client computer or network enabled device.

In a further embodiment the Intelligent Distribution Network system allows for automated setup of content providers encoding computer or other encoder network enabled devices so that they are pre configured and able to take best advantage of the Intelligent Distribution Network system with little or no interaction from the content provider.

In figure 7, an example of a Streaming Media Distribution Centre is shown that contains 'live' Stream Node Servers, 130, and 'On Demand' Stream Node Distribution Servers that are managed by the Content Management system. The sources of content can be delivered to the Streaming Media Distribution Centre by a LIVE Stream Content Source, 120, a TV / Radio Broadcast, 121, a LIVE – On Location Source, 122, and these contents may be transmitted to the Streaming Media Distribution Centre by Satellite, 123, via a 10 Mbps Satellite link, 126, or Public Internet, 124, over a 100Mbsp Fibre link, 127, or Private ISDN / PSTN Line, 125, over an ISDN / V.90 Dialup connection, 128, to deliver Encoded / Unencoded Content, 129. The Streaming Media Distribution Centre uses Distribution Broadcast Streams, 132, to deliver content over an ISDN / V.90 Dialup link, 134 to a Direct ISDN / Dialup, 136 onto ISDN / Dialup Users, 138. The Distribution Broadcast Streams, 132, are also used to streams of content over a 100Mbps Fibre link, 133, to the Public Internet, 135, onto ISP Streaming Node Servers, 137.

In a further embodiment the data contained within the Intelligent Distribution System databases is used to dynamically route network paths for any type of data that has to travel from a singularity or plurality of client or host adaptors on a network of interconnected electronic paths, to a singularity or plurality of client or host adaptors on a network of interconnected electronic paths. In this embodiment, figure 9, the IDN Configures a Streaming Node, 408, on the fly to on-stream data from a client, 401, to other streaming nodes, or to another client, 400, to form a 'virtual' route, 407, and 406, on a network which have significantly better performance than the Electronic "Static" Route formed in network links, 403, 402, 404, and 405. These virtual routes are determined within the IDN system artificial intelligence through the use of neural nets or other modelling systems. This may include, but not be limited to, quality of service other network management issues. For example, the IDN system could be used to dynamically route voice over IP connections over paths that best suite the time of day or network usage whereby these paths may be given higher, equal, or lower priority to network resources than other form of data. In this embodiment the streaming node itself may take on the functionality of a router device.

In a further embodiment content may exist on Streaming Media Servers on the Internet, in Streaming Media Servers at the IDN, or content may be cached in the Streaming Nodes for direct broadcast to client adaptors.

The Intelligent Distribution Network system will by nature dynamically map the behaviour of the Internet. In figure 10, a scatter diagram is shown where an IDN Trace Engine (figure 3, 105) has traced routes for approximately four hundred visits to an IDN server, 503. It can be seen in from this real event case, Figure 10, where network links, 502, map network client adaptors or routers, 501, over consecutive layers of network hops, 504, that there are points within the Internet infrastructure where data converges or expands, 500. These data convergent or expansive points, 500, benefit when functioning as Internet Streaming Node locations within the IDN system and the Internet.

In a further embodiment a stream of content is streamed over the IDN system in with a plurality of content start time intervals, therefore causing the same plurality of bandwidth increases within the Wide Area Network infrastructure. Such plurality of content streams allows for a singularity or plurality of client adaptors to received the streamed content from a plurality of relative timing points within the content stream from the zenith, or start of the stream. For example, a major feature movie of 200 minutes duration is rebroadcast as a separate stream every 20 minutes. Thus over 200 minutes, the length of the content, there are 10 times 20 minute delayed broadcast of the movie being streamed. The bandwidth consumption over WAN is ten fold that of a single stream of the same content. However, any client adaptor is able to join the stream of the content so that they are within 20 minutes from the start of the movie event. The IDN system may stream the client adaptor 20 minutes of advertising, trailer adds for other movies, or other content, until the start of the movie stream has come around again and they are able to watch the movie event from is zenith, or start. In this way a quasi video on demand system can be delivered to client adaptors whilst presenting acceptable ergonomic conditions to the consumer of the movie event, and at the same time conserve to the Wide Area Network infrastructure by utilising reasonable economic bandwidth consumption.

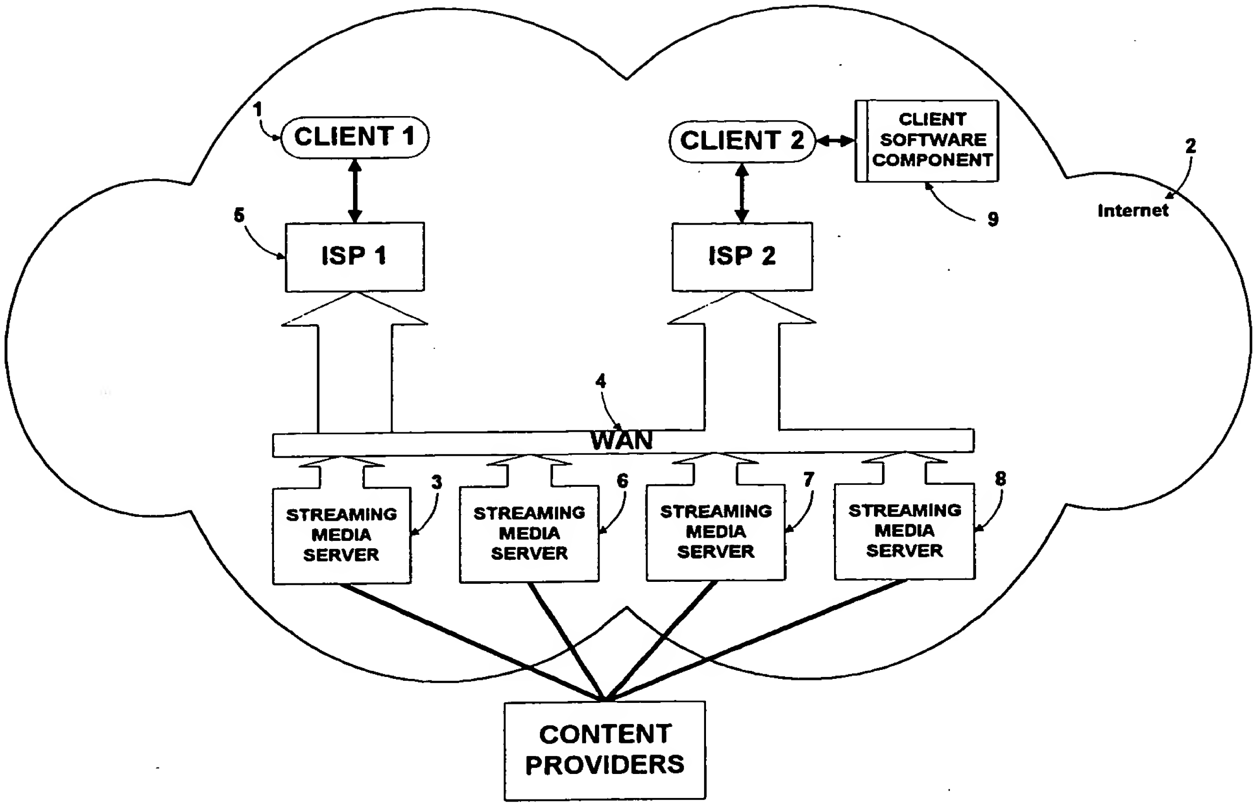
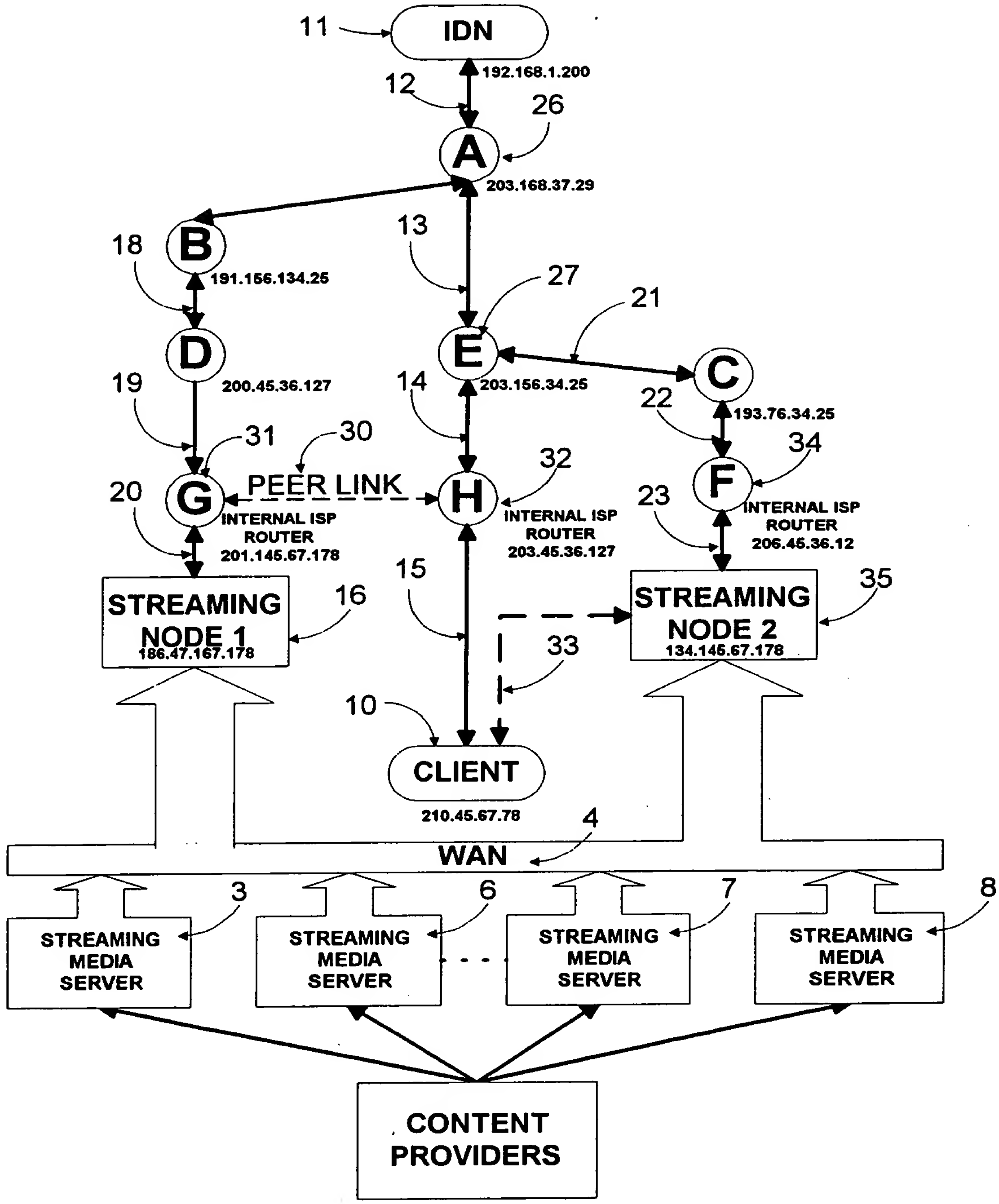

1
CLIENT 1
CLIENT 2
CLIENT SOFTWARE COMPONENT
2
Internet
9
5
ISP 1
ISP 2
4
WAN
3
6
7
8
STREAMING MEDIA SERVER
STREAMING MEDIA SERVER
STREAMING MEDIA SERVER
STREAMING MEDIA SERVER
CONTENT PROVIDERS

Figure 1



11
IDN
192.168.1.200
12
26
A
203.168.37.29
13
B
18
191.156.134.25
27
21
D
E
C
19
200.45.36.127
14
203.156.34.25
22
193.76.34.25
31
30
34
PEER LINK
32
20
G
H
F
23
INTERNAL ISP
ROUTER
201.145.67.178
INTERNAL ISP
ROUTER
203.45.36.127
INTERNAL ISP
ROUTER
206.45.36.12
15
35
STREAMING
NODE 1
186.47.167.178
16
STREAMING
NODE 2
134.145.67.178
33
10
CLIENT
210.45.67.78
4
WAN
3
6
7
8
STREAMING
MEDIA
SERVER
STREAMING
MEDIA
SERVER
STREAMING
MEDIA
SERVER
STREAMING
MEDIA
SERVER
CONTENT
PROVIDERS

Figure 2

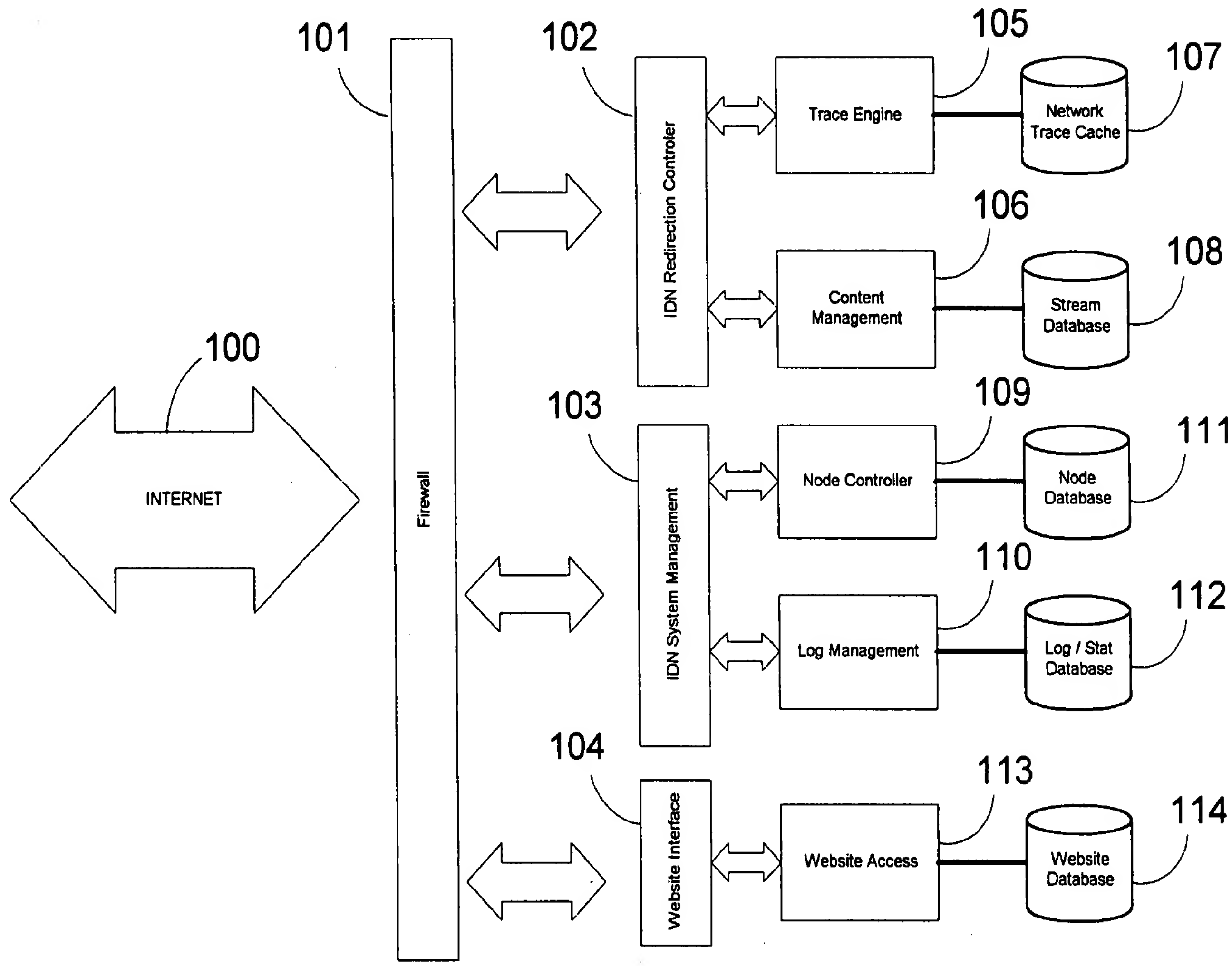

100
INTERNET
101
Firewall
102
IDN Redirection Controler
103
IDN System Management
104
Website Interface
105
Trace Engine
106
Content Management
109
Node Controller
110
Log Management
113
Website Access
107
Network Trace Cache
108
Stream Database
111
Node Database
112
Log / Stat Database
114
Website Database

Figure 3

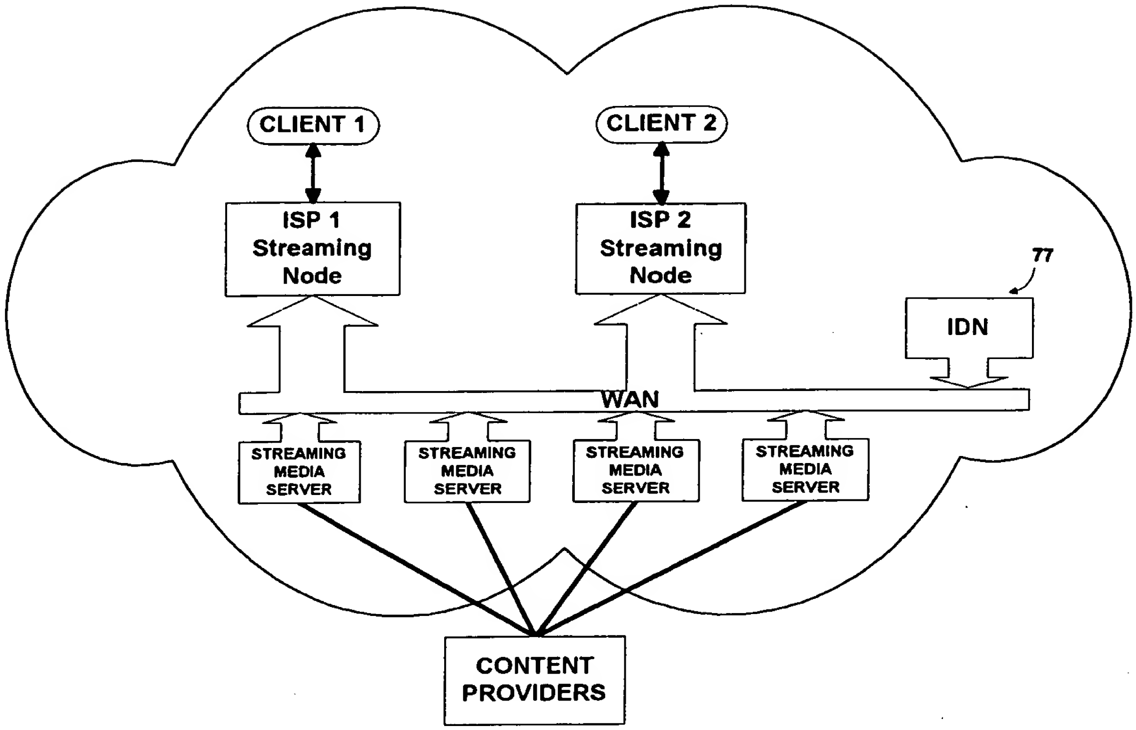


Figure 4

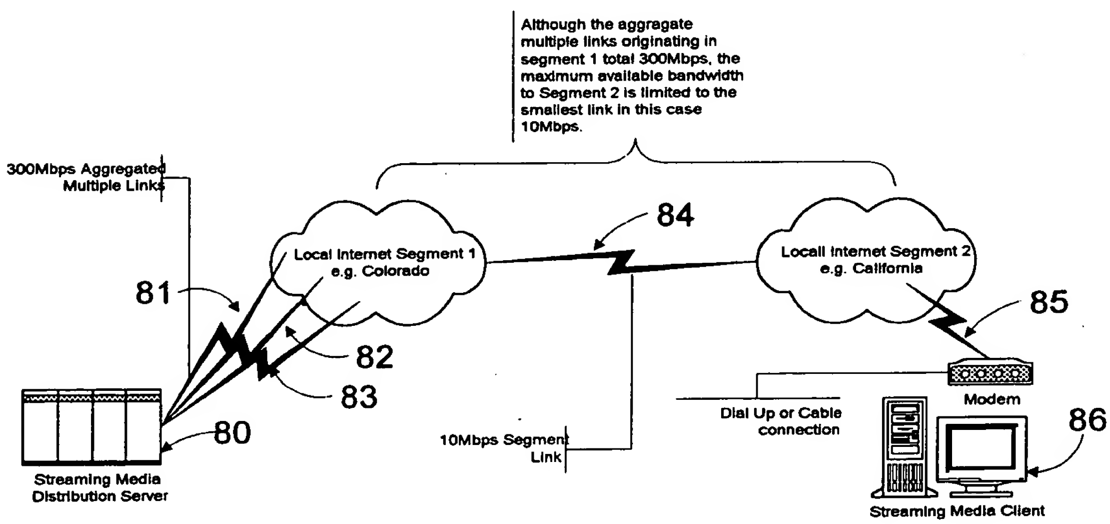
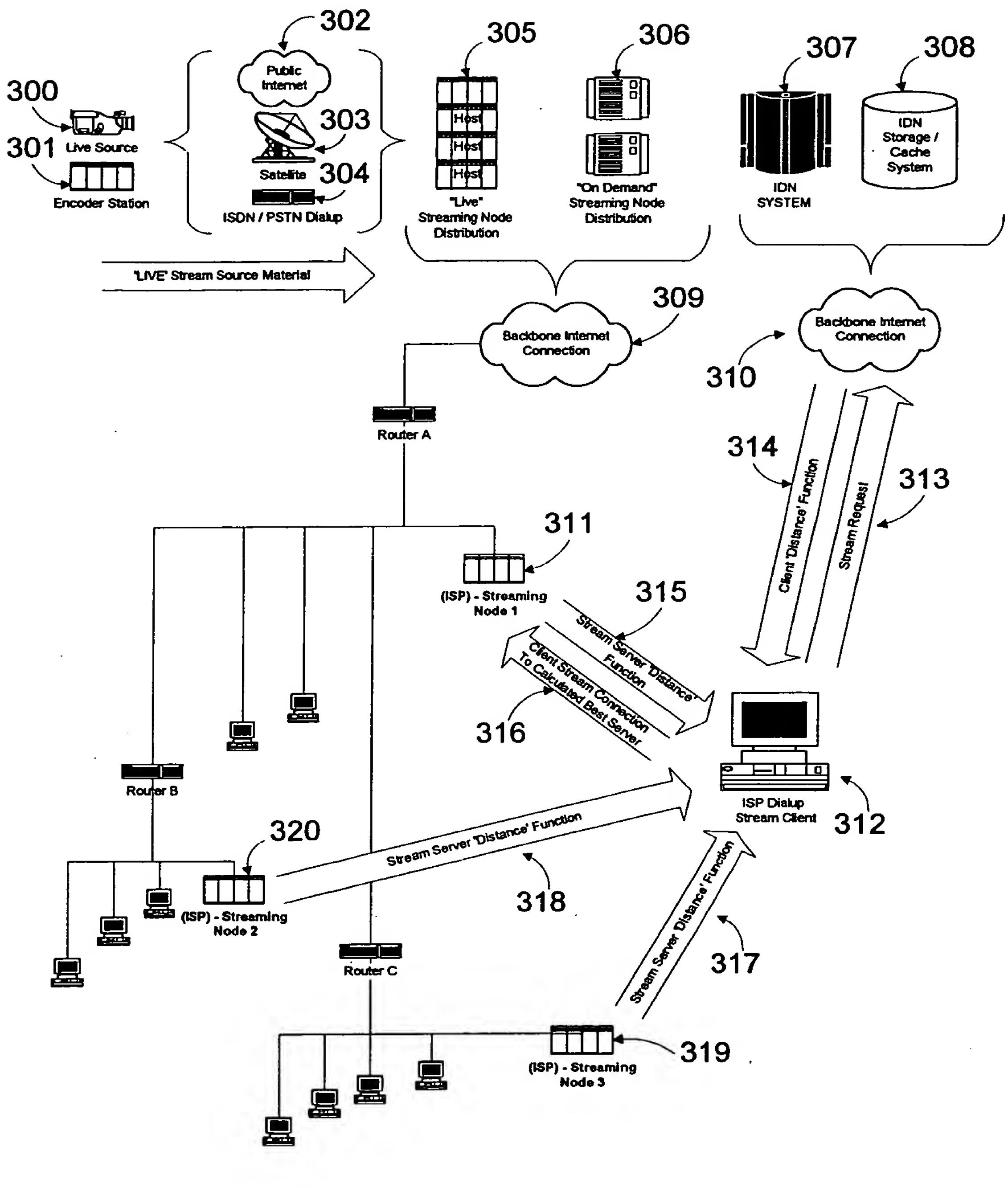
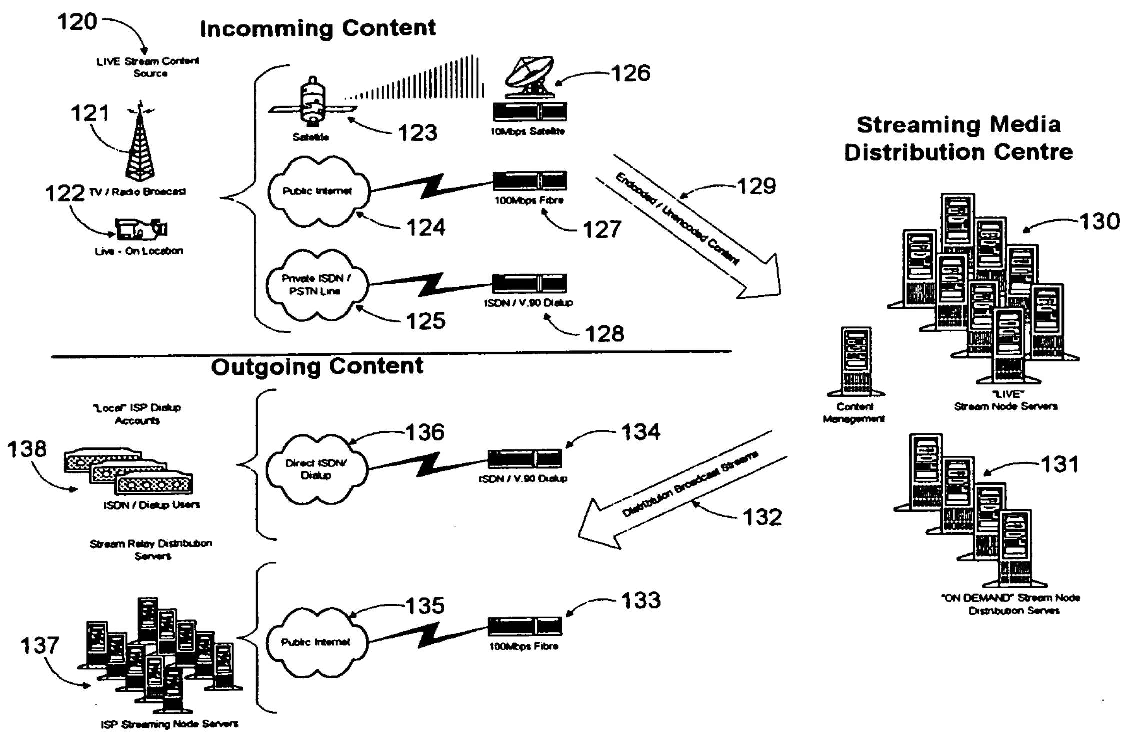


Figure 5



300
301
Live Source
Encoder Station
302
Public Internet
303
Satellite
304
ISDN / PSTN Dialup
'LIVE' Stream Source Material
305
Host
Host
Host
"Live" Streaming Node Distribution
306
"On Demand" Streaming Node Distribution
307
IDN SYSTEM
308
IDN Storage / Cache System
309
Backbone Internet Connection
310
Backbone Internet Connection
Router A
311
(ISP) - Streaming Node 1
314
Client 'Distance' Function
313
Stream Request
315
Stream Server 'Distance' Function
316
Client Stream Connection To Calculated Best Server
ISP Dialup Stream Client
312
Router B
320
(ISP) - Streaming Node 2
Stream Server 'Distance' Function
318
Stream Server 'Distance' Function
317
Router C
319
(ISP) - Streaming Node 3

Figure 6



120
Incomming Content
LIVE Stream Content Source
121
122 TV / Radio Broadcast
Live - On Location
Satellite
123
126
10Mbps Satellite
Public Internet
124
100Mbps Fibre
127
Private ISDN / PSTN Line
125
ISDN / V.90 Dialup
128
Encoded / Unencoded Content
129
Streaming Media
Distribution Centre
130
Content Management
"LIVE" Stream Node Servers
131
"ON DEMAND" Stream Node Distribution Servers
Outgoing Content
"Local" ISP Dialup Accounts
138
ISDN / Dialup Users
Direct ISDN/ Dialup
136
134
ISDN / V.90 Dialup
Distribution Broadcast Streams
132
Stream Relay Distribution Servers
137
ISP Streaming Node Servers
Public Internet
135
133
100Mbps Fibre

Figure 7

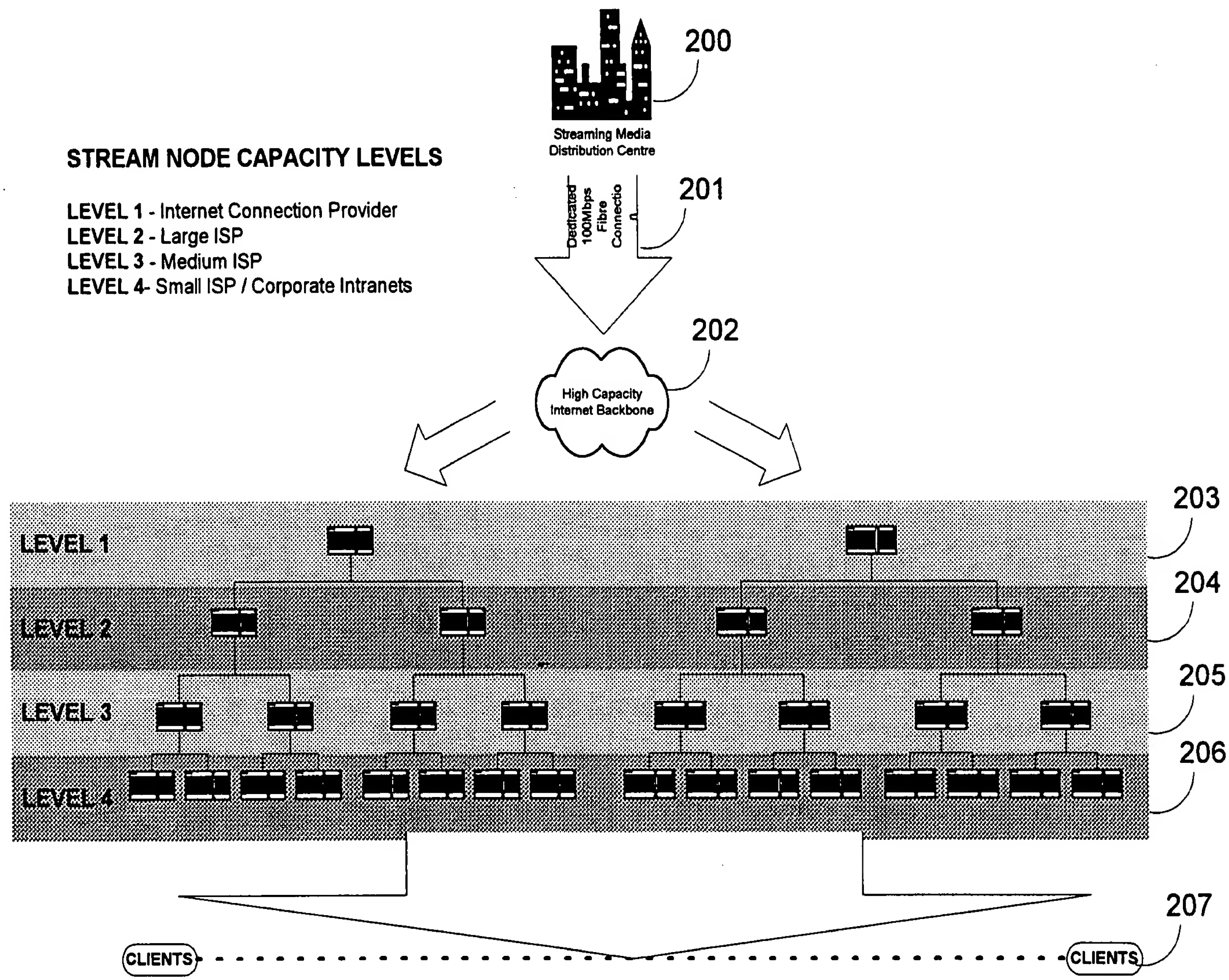
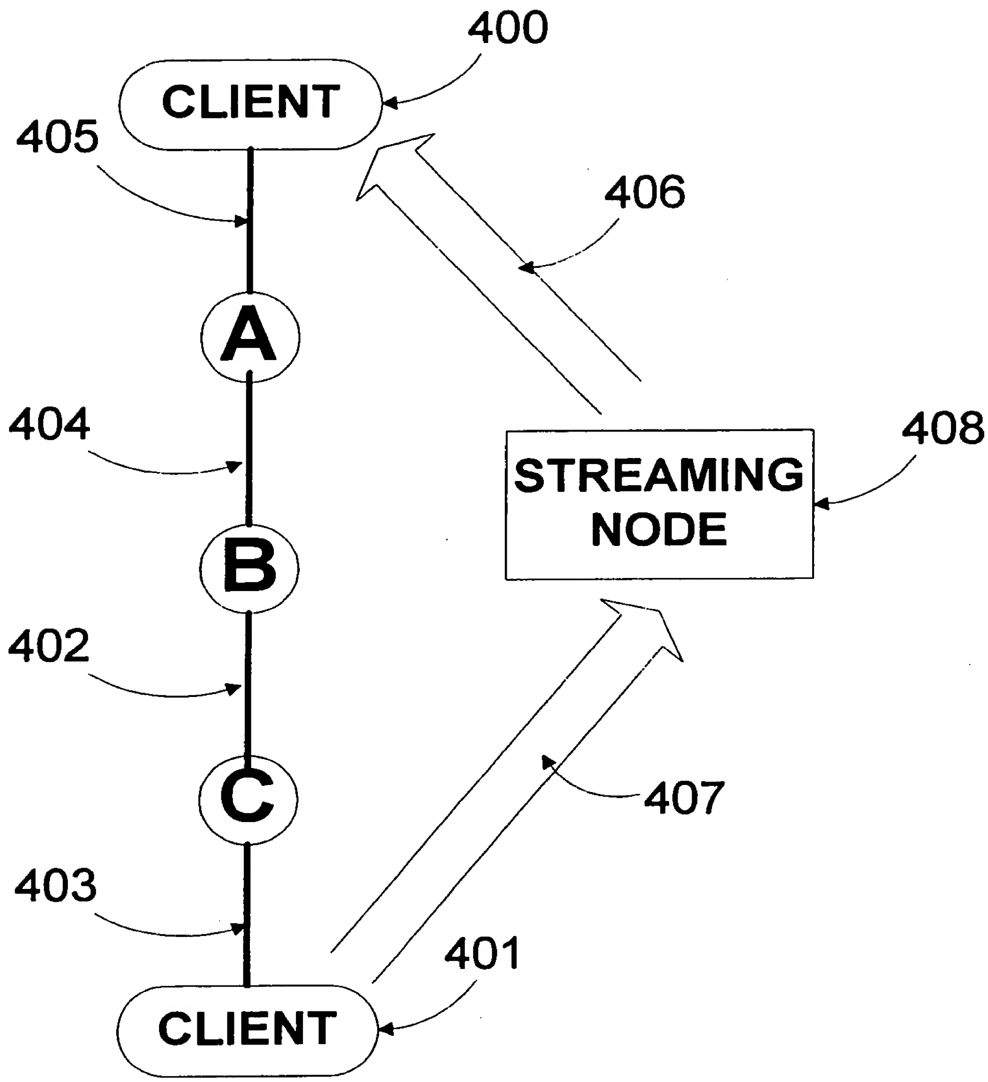

STREAM NODE CAPACITY LEVELS
LEVEL 1 - Internet Connection Provider
LEVEL 2 - Large ISP
LEVEL 3 - Medium ISP
LEVEL 4- Small ISP / Corporate Intranets
200
Streaming Media Distribution Centre
201
Dedicated 100Mbps Fibre Connection
202
High Capacity Internet Backbone
203
204
205
206
207
LEVEL 1
LEVEL 2
LEVEL 3
LEVEL 4
CLIENTS
CLIENTS

Figure 8



400
CLIENT
405
406
A
404
408
STREAMING NODE
B
402
C
407
403
401
CLIENT

Figure 9

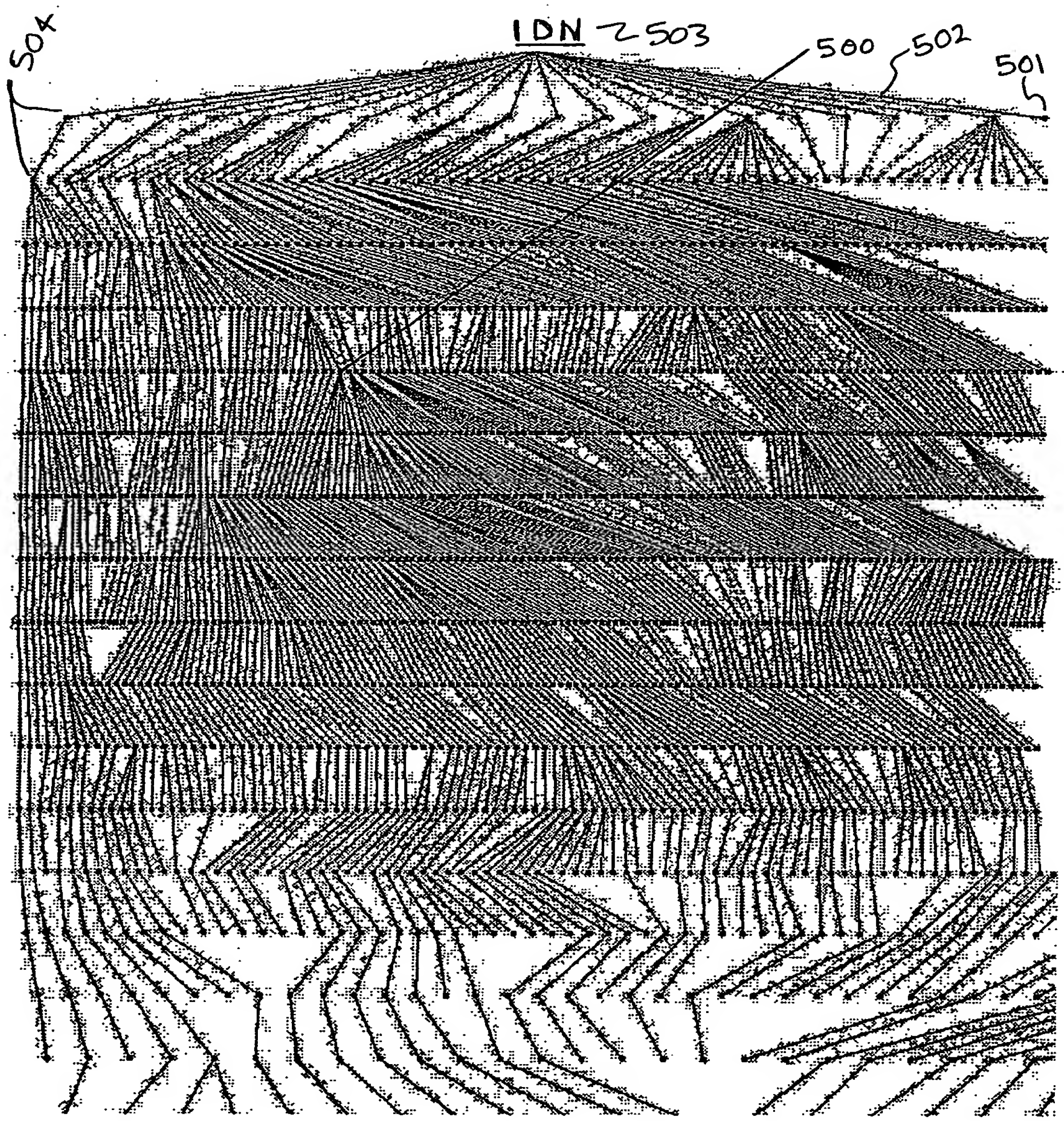


Figure-10